

**REMARKS**

Claims 1-54 are pending. Claims 1, 14, 27, 28, 29, 41, 53 and 54 have been amended way of the present amendment. Reconsideration is respectfully requested.

In the outstanding Office Action, claim 27 was objected to due to informalities; claims 14-27 and 41-53 were rejected under 35 U.S.C. Section 101 because the claimed invention is directed to non-statutory subject matter; claims 1-8, 29-35, 53 and 54 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over “Wavelet-based reversible watermarking for authentication” (Tian) in view of “Distortion-Free Data Embedding for Images” (Goljan et al.); claims 9-10 and 36-37 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. and further in view of U.S. Patent No. 6,535,616 (Hayashi et al.); claim 11-13 and 38-40 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. and further in view of U.S. Patent Publication No. US 2004/0250079 (Stach et al.); claims 14-26 and 41-52 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. and further in view of U.S. Patent No. 6,385,329 (Sharma et al.); Reconsideration is respectfully requested.

***Claim Objections***

Claim 27 was objected to due to informalities. In response to the objection, claim 27 has been amended to correct the indicated spelling error. Therefore, it is respectfully requested that the outstanding objection be withdrawn.

***35 U.S.C Section 101 Rejections***

Claims 14-27 and 41-53 were rejected under 35 U.S.C. Section 101 because the claimed invention is directed to non-statutory subject matter. Reconsideration is respectfully requested.

Amended claim 14 recites:

[a]n apparatus including a processor operating under the instructions of a software program, the software program causing the apparatus to perform actions, comprising:

*preprocessing an original pixel domain image to modify any data plotted at extremes of an ordinate axis of the original pixel domain image;*

subjecting the preprocessed pixel domain image to an Integer Wavelet Transform (IWT) to obtain a matrix of wavelet coefficients;

selecting at least one bit plane between a least significant bit plane and a most significant bit plane of the matrix of wavelet coefficients;

compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;

embedding hidden data in the free space of the at least one compressed bit plane; and

subjecting the at least one embedded bit plane and the other bit planes to an Inverse IWT *to produce a marked pixel domain image* (emphasis added).

The result of the claimed invention is to: “produce a marked pixel domain image” from “an original pixel domain image.” As indicated in the outstanding Office Action:

[i]n order for the claimed product to produce a “useful, concrete and tangible” result, recitation of one or more of the following elements is suggested:

The manipulation of data that represents a physical object or activity transformed from outside of the computer.

A physical transformation outside the computer, for example in the form of pre or post computer processing activity.

A direct recitation of a practical application.<sup>1</sup>

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<sup>1</sup> See Office Action, at page 3, lines 17-20:

As can be seen from **FIG. 2**, the “original pixel domain image” clearly represents *a physical object* (e.g., an original image or picture of a physical object) *from outside of the computer* and the claim limitations that result in producing a “marked pixel domain image” represent manipulation of data that represents a physical object (e.g., an original image or picture of a physical object) or activity transformed from outside of the computer. Therefore, it is respectfully submitted that the claimed invention is clearly produces a useful, concrete and tangible result. As indicated in the outstanding Office Action To satisfy the utility requirement of 25 U.S.C. Section 101, the result of the claimed invention.

Amended claim 41 recites:

[a]n apparatus including a processor operating under the instructions of a software program, the software program causing the apparatus to perform actions, comprising:

subjecting a marked pixel domain image to an Integer Wavelet Transform (IWT) to obtain a matrix of wavelet coefficients;

selecting at least one bit plane between a least significant bit plane and a most significant bit plane of the matrix of wavelet coefficients that contains hidden data;

extracting the hidden data from the at least one bit plane;

decompressing the at least one bit plane;

subjecting all bit planes to an Inverse IWT; and

postprocessing the output of the Inverse IWT to recover original histogram information *and produce an original pixel domain image* (emphasis added).

The result of the claimed invention is to: “produce an original pixel domain image” from “a marked pixel domain image.” As indicated in the outstanding Office Action:

[i]n order for the claimed product to produce a “*useful, concrete and tangible*” result, recitation of one or more of the following elements is suggested:

The manipulation of data that represents a physical object or activity transformed from outside of the computer.

A physical transformation outside the computer, for example in the form of pre or post computer processing activity.

A direct recitation of a practical application. (emphasis added).<sup>2</sup>

As can be seen from **FIG. 3**, the “marked pixel domain image” is clearly the result of *manipulation of data that represents a physical object* (i.e., an original image or picture of the object) or activity transformed from outside of the computer; and producing an “original pixel domain image” is the result of the *manipulation of data that represents a physical object* or activity and the result is transformed for use *outside of the computer*.

In addition, with respect to claims 27 and 53, it is respectfully submitted that the outstanding Office Action states:

[w]hen functional descriptive material is recorded on some computer-readable medium it becomes structurally and functionally interrelated to the medium and will be statutory in most cases.

Further, as suggested in the outstanding Office Action, claims 27 and 53 have been amended to recite: “a computer-readable storage medium containing a software program” to clearly make the claims statutory. Support for the amendments is provided at least in paragraph [0008] of both the originally filed specification and U.S. Patent Application Publication US 2006/0126890. Therefore, it is respectfully submitted that claims 14-27 and 41-53 clearly produce useful, concrete and tangible results and are statutory; and it is respectfully requested that the U.S.C. Section 101 rejections should be withdrawn.

### ***35 U.S.C Section 103 Rejections***

Claims 1-8, 29-35, 53 and 54 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. Reconsideration is respectfully requested.

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<sup>2</sup> See Office Action, at page 3, lines 17-20:

Independent claims 1, 14, 27, 28, 29, 41, 53 and 54 have been amended to clarify the invention.

In particular, claim 1 has been amended to recite:

~~preprocessing an original pixel domain image to modify data plotted at extremes of an ordinate axis of the original pixel domain image;~~

~~subjecting an original, the preprocessed pixel domain image to an Integer Wavelet Transform (IWT) to obtain a matrix of wavelet coefficients;~~

~~selecting at least one bit plane between a least significant bit plane and a most significant bit plane of the matrix of wavelet coefficients;~~

~~compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;~~

~~embedding hidden data in the free space of the at least one compressed bit plane; and~~

~~subjecting the at least one embedded bit plane and the other bit planes to an Inverse IWT to produce a marked pixel domain image.~~

Independent claims 1, 14, 27 and 28 are amended with similar language.

In addition, claim 29 has been amended to recite:

[a] method, comprising:

~~subjecting a marked pixel domain image to an Integer Wavelet Transform (IWT) to obtain a matrix of wavelet coefficients;~~

~~selecting at least one bit plane between a least significant bit plane and a most significant bit plane of the matrix of wavelet coefficients that contains hidden data;~~

~~extracting the hidden data from the at least one bit plane; decompressing the at least one bit plane; and~~

~~subjecting all bit planes to an Inverse IWT; and to postprocessing the output of the Inverse IWT to recover original histogram information and produce an original pixel domain image.~~

Independent claims 29, 41 and 53 have been amended with similar language. Support for the amendments is at least in **FIG. 2** and **FIG. 3**, at references **102** and **210**, respectively; and provided at least in paragraph **[0029]** to **[0031]** and **[0038]** of the originally filed specification and paragraphs **[0036]** to **[0038]** and paragraph **[0045]** of Patent Application Publication No. US 2006/0126890. Therefore, it is respectfully submitted that the amendments raise no questions of new matter.

Tian discloses a method that finds out the average and difference of two original pixel values by working on two original pixels that are horizontally and vertically neighbored. In addition, since two neighboring pixels are often highly correlated (i.e., except for edge and sharp transition area) for natural images, the difference between the two neighboring pixels is often small and two new pixel values, which are generated by the method, are still within the range from 0 to 255 (considering 8-bit grayscale image). Further, Tian discloses that, through data extraction, the method: (1) works on the two new pixel values; (2) finds out their difference and expresses that difference in binary representation; (3) extracts the embedded bit; and (3) recovers the original difference value. Furthermore, Tian discloses that, with the original difference value and the original average value, he can recover the two original pixel values can be recovered.

However, Tian nowhere discloses, as the claimed invention recites:

*preprocessing an original pixel domain image to modify data plotted at extremes of an ordinate axis of the original pixel domain image;*

*subjecting the preprocessed pixel domain image to an Integer Wavelet Transform (IWT) to obtain a matrix of wavelet coefficients;*

*selecting at least one bit plane between a least significant bit plane and a most significant bit plane of the matrix of wavelet coefficients;*

*compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;*

*embedding hidden data in the free space of the at least one compressed bit plane* (emphasis added).

That is, once the method of Tian has expanded the difference, an underflow and/or overflow may take place. Bookkeeping to avoid underflow and/or overflow is the key issues in lossless data hiding. If the bookkeeping is too complicated and hence takes too much data, then lossless data hiding may not be able to be implemented. This issue is in fact a constraint which has prohibited the method disclosed by Tian from being applied to more advanced and more complicated, integer wavelet transforms such as the Haar transform. In contrast to Tian and to deal with this issue, the claimed invention recites: “preprocessing an original pixel domain image to modify data plotted at extremes of an ordinate axis of the original pixel domain image.” Moreover, as indicated in the outstanding Office Action, Tian also does not disclose, as the independent claims recite: “selecting at least one bit plane between a least significant bit plane and a most significant bit plane of the matrix of wavelet coefficients.”

Moreover, Tian nowhere discloses as the claim invention recites:

extracting the hidden data from the at least one bit plane;  
decompressing the at least one bit plane;  
subjecting all bit planes to an Inverse IWT; and  
*postprocessing the output of the Inverse IWT to recover original histogram information and produce an original pixel domain image* (emphasis added).

Thus, in consideration of the above discussion, it is respectfully submitted that Tian nowhere discloses all the limitations of the claimed invention.

The outstanding Office Action acknowledges deficiencies of Tian and attempts to overcome those deficiencies by combining Goljan et al. with Tian. However, Goljan et al. cannot overcome all of the deficiencies of Tian, as discussed below. In particular, Goljan et al. nowhere discloses, as the claimed invention recites:

*preprocessing an original pixel domain image to modify data plotted at extremes of an ordinate axis of the original pixel domain image;*  
selecting at least one bit plane between a least significant bit plane and a most significant bit plane *of the matrix of wavelet coefficients;*  
compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;  
*embedding hidden data in the free space of the at least one compressed bit plane* (emphasis added).

That is, due to the fact that the high frequency wavelet coefficients obey the Laplacian distribution, the least significant bit-plan of “the matrix of wavelet coefficients,” as recited in the claimed invention, have a significantly larger number of zeroes than the least-significant bit-plane(s) of pixel values, as disclosed by Goljan et al. Thus, due to the significantly larger number of zeroes in the “matrix of wavelet coefficients” of the claimed invention, the ability to compress by “*embedding hidden data in the free space of the at least one compressed bit plane*,” as recited in the claimed invention, is significantly larger than the data embedding capacity disclosed by Goljan et al.

Further, Goljan et al. nowhere discloses bit-plane compression of “wavelet coefficients,” as recited in the claimed invention. That is, Goljan et al. discloses compressing the least significant bit-plane(s) of *image pixels* (i.e., in the image pixel domain) in contrast to the claimed invention, which is directed toward compressing high-frequency *wavelet coefficients* (i.e., in the wavelet transform domain).

Thus, it is respectfully submitted that Goljan et al. is directed toward a different compression approach and the compression of a different quantity than that of the claimed invention.

Moreover, Goljan et al. nowhere discloses as the claim invention recites:

extracting the hidden data from the at least one bit plane;  
decompressing the at least one bit plane;  
subjecting all bit planes to an Inverse IWT; and  
*postprocessing the output of the Inverse IWT to recover original histogram information and produce an original pixel domain image* (emphasis added).

Therefore, in consideration of the above discussion, it is respectfully submitted that neither Tian nor Goljan et al., whether taken alone or in combination, disclose, suggest or make obvious the claimed invention and that independent claims 1, 14, 27-29, 41, 53 and 54, and claims dependent thereon, patentably distinguish thereover.

Claims 9-10 and 36-37 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. and further in view of Hayashi et al. Reconsideration is respectfully requested.

Claims 9-10 and 36-37 ultimately depend upon claim 1 and claim 29. As discussed above, claims 1 and 29 are not disclosed by Tian or Goljan et al. For at least these same reasons, claims 9-10 and 36-37 are also not disclosed by Tian or Goljan et al.

The outstanding Office Action acknowledges deficiencies of Tian and Goljan et al. and attempts to overcome those deficiencies by combining Hayashi et al. with Tian and Goljan et al. However, Hayashi et al. cannot overcome all of the deficiencies of Tian and Goljan et al. as discussed below. In particular, Hayashi et al. nowhere discloses, as the claimed invention recites:

*preprocessing an original pixel domain image to modify data plotted at extremes of an ordinate axis of the original pixel domain image;*  
selecting at least one bit plane between a least significant bit plane and a most significant bit plane *of the matrix of wavelet coefficients;*  
compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;

*embedding hidden data in the free space of the at least one compressed bit plane* (emphasis added).

Moreover, Hayashi et al. nowhere discloses as the claim invention recites:

*extracting the hidden data from the at least one bit plane;  
decompressing the at least one bit plane;  
subjecting all bit planes to an Inverse IWT; and  
postprocessing the output of the Inverse IWT to recover  
original histogram information and produce an original pixel  
domain image* (emphasis added).

Thus, Hayashi et al. cannot overcome all of the deficiencies of Tian and Goljan et al. Therefore, in consideration of the above discussion, it is respectfully submitted that none of Tian Goljan et al., nor Hayashi et al., whether taken alone or in combination, disclose, suggest or make obvious the claimed invention and that claims 9-10 and 36-37, and claims dependent thereon, patentably distinguish thereover.

Claim 11-13 and 38-40 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. and further in view of Stach et al. Reconsideration is respectfully requested.

Claims 11-13 and 38-40 ultimately depend upon claim 1 and claim 29. As discussed above, claims 1 and 29 are not disclosed by Tian or Goljan et al. For at least these same reasons, claims 11-13 and 38-40 are also not disclosed by Tian or Goljan et al.

The outstanding Office Action acknowledges deficiencies of Tian and Goljan et al. and attempts to overcome those deficiencies by combining Stach et al. with Tian and Goljan et al. However, Hayashi et al. cannot overcome all of the deficiencies of Tian and Goljan et al. as discussed below. In particular, Stach et al. nowhere discloses, as the claimed invention recites:

*preprocessing an original pixel domain image to modify  
data plotted at extremes of an ordinate axis of the original pixel  
domain image;*

*selecting at least one bit plane between a least significant  
bit plane and a most significant bit plane of the matrix of wavelet  
coefficients;*

compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;  
*embedding hidden data in the free space of the at least one compressed bit plane* (emphasis added).

Moreover, Stach et al. nowhere discloses as the claim invention recites:

extracting the hidden data from the at least one bit plane;  
decompressing the at least one bit plane;  
subjecting all bit planes to an Inverse IWT; and  
*postprocessing the output of the Inverse IWT to recover original histogram information and produce an original pixel domain image* (emphasis added).

Thus, Stach et al. cannot overcome all of the deficiencies of Tian and Goljan et al. Therefore, in consideration of the above discussion, it is respectfully submitted that none of Tian Goljan et al., nor Stach et al., whether taken alone or in combination, disclose, suggest or make obvious the claimed invention and that claims 11-18 and 38-40, and claims dependent thereon, patentably distinguish thereover.

Claims 14-26 and 41-52 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Tian in view of Goljan et al. and further in view of Sharma et al. Reconsideration is respectfully requested.

Claims 14-26 and 41-52 ultimately depend upon claim 14 and claim 29. As discussed above, claims 14 and 29 are not disclosed by Tian or Goljan et al. For at least these same reasons, claims 14-26 and 41-52 are also not disclosed by Tian or Goljan et al.

The outstanding Office Action acknowledges deficiencies of Tian and Goljan et al. and attempts to overcome those deficiencies by combining Sharma et al. with Tian and Goljan et al. However, Sharma et al. cannot overcome all of the deficiencies of Tian and Goljan et al. as discussed below. In particular, Sharma et al. nowhere discloses, as the claimed invention recites:

*preprocessing an original pixel domain image to modify data plotted at extremes of an ordinate axis of the original pixel domain image;*

selecting at least one bit plane between a least significant bit plane and a most significant bit plane *of the matrix of wavelet coefficients*;

compressing the at least one selected bit plane to produce free space in the at least one selected bit plane;

*embedding hidden data in the free space of the at least one compressed bit plane* (emphasis added).

Moreover, Sharma et al. nowhere discloses as the claim invention recites:

extracting the hidden data from the at least one bit plane;

decompressing the at least one bit plane;

subjecting all bit planes to an Inverse IWT; and

*postprocessing the output of the Inverse IWT to recover original histogram information and produce an original pixel domain image* (emphasis added).

Thus, Sharma et al. cannot overcome all of the deficiencies of Tian and Goljan et al. Therefore, in consideration of the above discussion, it is respectfully submitted that none of Tian Goljan et al., nor Sharma et al., whether taken alone or in combination, disclose, suggest or make obvious the claimed invention and that claims 14-26 and 41-52, and claims dependent thereon, patentably distinguish thereover.

### ***Conclusions***

Applicant believes no fee is due with this response. However, if a fee is due, please charge HP Deposit Account No. 08-2025, under Order No. 200314273-1 from which the undersigned is authorized to draw.

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Respectfully submitted,

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